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A PRECAUTIONARY TALE ABOUT RARITY: ON THE LARVA AND LIFE HISTORY OF *LITHOPHANE JOANNIS* (LEPIDOPTERA: NOCTUIDAE)

Additional key words: shelter-forming, *Aesculus flava*, *Lithophane innominata*, *Lithophane patefacta*

This note is about rarity, and how species that are regarded as scarce may be anything but, once aspects of their life history are better understood. *Lithophane joannis* Covell and Metzler was not described until 1992. Prior to the authors' distribution of paratypes there were no specimens of *L. joannis* in any major eastern institution, i.e., the Smithsonian, American Museum, and Carnegie Museum. Not William Forbes; nor Jack Franclemont, Doug Ferguson, Michael Pogue, Eric Quinter, or Tim McCabe has collected the moth. Dale Schweitzer wrote his dissertation on the tribe—he has yet to see the moth alive. Despite year-round surveys in Great Smoky Mountains National Park (GSMNP)—and especially over the last five years during which time the Park has been the focus of intensive surveys as part of its "All Taxon Biodiversity Inventory"—the moth escaped detection. Yet *Lithophane joannis* is among the Park's most common lepidopterans in middle elevation cove forests.

On 19 May 2001 I collected two *Lithophane* larvae crawling up the trunk of a small yellow buckeye tree (*Aesculus flava* Ait.) (Hippocastanaceae) while collecting moths at a sheet and mercury light (with Doug Ferguson), above the Chimneys Campground (1000m) in Great Smoky Mountains National Park, Sevier County, Tennessee. The caterpillars looked similar to those of the *innominata* group (e.g., *L. hemina* Grote, *L. patefacta* (Walker), *L. petulca* Grote and *L. innominata* (Small), and others), but different enough to raise doubt. Based on the host association and phenotype, Dale Schweitzer guessed that the larvae were those of *Lithophane joannis*. Return trips to the same pullout along Newfound Gap Road in 2002, 2003, and 2004, yielded additional examples of the *Lithophane*. Typically, only one or two caterpillars were collected each year. Unfortunately, I failed repeatedly to rear examples through to the adult stage-inappropriate foliage was offered or larvae were lost during the obligatory, four-month prepupal diapause common to *Lithophane* and other xylenines. In 2005, while light trapping at the same site above the Chimneys Picnic area, I thoroughly searched the same 4m yellow buckeye tree that had yielded caterpillars in every year previous. Nine *Lithophane* caterpillars were found in 20 minutes of searching (by flashlight). The larvae were feeding, perched on the underside of leaves, or observed walking along the trunk, with the exception of two larvae that were recovered from within leaf shelters. Both of these latter individuals were in the process of molting.

Returning to the same area two days later (20 May, 2005), I happened upon a buckeye tree with numerous leaf shelters. Upon opening the first, I found a last instar *Lithophane*. Searching this same tree I counted more than 20 additional *Lithophane joannis* caterpillars in less than 10 minutes by opening other leaf shelters. Nearly every shelter had a caterpillar and some two (few if any of these were in the process of a molt). No additional

caterpillars were obtained by beating limbs of the same tree over a large queen-sized bed sheet. In late September, a series of *Lithophane joannis* issued from this collection (Fig. 1).

The larva of *Lithophane joannis* is strongly mottled (Fig. 2). There is often a straw to yellow tint where adjacent segments overlap and/or a tan to straw flush to the middorsal and lateral stripes. The white dorsal pinacula (D1 and D2 setae) are edged with black; both dorsal pinacula are often embedded in a diffuse dark patch that is best developed over the eighth abdominal segment. The well-differentiated prothoracic shield is heavily blackened above the subdorsal stripe. Below the lateral stripe the subventer and venter are pale and largely unmarked. The head bears a dark coronal bar, a black spot within the frons (frontal triangle), and a black bar above each antenna. Fully mature last instars are about 4 cm in length. The middle and penultimate instars are lime green, translucent, with a strong, somewhat creamy spiracular stripe and a broken, white middorsal stripe; the body bears numerous minute white spots over the trunk (Fig. 3). In appearance the last instars resemble those of *L. hemina* and *L. innominata* and may not be separable from them, although most individuals will be recognizable by their pale ground color, especially those individuals that have a pale green, yellowish, or steely blue cast. In most instances, larvae of *L. joannis* will be identifiable by their host association (with buckeye).

No other eastern *Lithophane* is known to consistently take up residence in leaf shelters. Other members of the *innominata* complex typically rest in bark crevices by day (Wagner 2005) Trunks of *Aesculus flava*—particularly on the understory trees where one can expect to find larvae in numbers—are often smooth and without fissures in which larvae could conceal themselves. It is not clear if *L. joannis* ever spins its own shelters or only uses those of other leps. In May 2006 a collection of 13 additional larvae was made from the Chimneys area of the Park—all came from leaf shelters of microlepidopterans. Eight were collected from abandoned and pupal shelters made by *Choristoneura fractivittana* (Clemens) (Tortricidae) and the remainder from prepupal and pupal shelters spun by *Yponomeuta multipunctella* Clemens[1] (Yponomeutidae).

Several *Lithophane* are known to be both predatory and cannibalistic, including the apparently closely-related *L. patefacta* (Schweitzer 1979; Wagner, 2005). While there would seem to be clear advantages to having the ability to take over previously spun shelters, cannibalism was not observed in five pint rearing containers that housed 3–5 middle and late instars. And as noted above, I occasionally found shelters with two larvae. Similarly, 10 of 13 larvae collected in 2006 came from occupied microlepidopteran shelters (see above)—no evidence of predation was noted in these (or any of the other shelters opened on the day of the initial collection in the Park).

[1]While *Yponomeuta multipunctella* larvae normally feed on *Euonymus*, since 2004 I have increasingly noted larvae on other hosts in the Smokies.

FIGS 1–3. *Lithophane joannis*: all from Chimneys area of Great Smoky Mountains National Park, Sevier County, Tennessee. **1**, Reared adult. **2**, *Lithophane joannis* last instar. **3**, Penultimate instar.

In the middle elevation cove forests of GSMNP where caterpillars of *Lithophane joannis* were discovered, the insect is among the most abundant noctuid caterpillars—on 20 May, 2005, *L. joannis* was arguably the most common noctuid caterpillar present in the Chimneys area. At the type locality in Ohio, *L. joannis* outnumbered all other members of the genus *Lithophane* at bait (Covell and Metzler 1992). Interestingly, adults ignored the light traps that were run at the same location (Eric Metzler pers. comm.). *L. joannis* provides a noteworthy case of apparent rarity—

if one were to depend on standard light trapping methods one would conclude that the moth is among the rarest lepidopterans in eastern North America. However if one employs bait or searches for caterpillars one could conclude just the opposite, that *L. joannis* is among the most common noctuids in Appalachian forests where its foodplant, *Aesculus flava*, grows in abundance.

Identification of the adults was confirmed by Eric Metzler. Vouchers of both larvae and adults have been deposited at the University of Connecticut; adults have also been deposited at the United States National Museum.

James Adams, Dale Schweitzer, and Bo Sullivan offered suggestions on an earlier draft of the paper and Rene Twarkins assisted with the larval images.

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DIURNAL HERBIVORY DOCUMENTED FOR *SPEYERIA IDALIA* (NYMPHALIDAE) LARVAE ON *VIOLA SAGITTATA* (VIOLACEAE) IN PENNSYLVANIA

Additional key words: regal fritillary, violet, foraging

Only two extant populations of the regal fritillary, *Speyeria idalia* Drury (Nymphalidae), are documented east of Indiana (Barton 1996 for Pennsylvania, Hobson 1999 and Chazal 2002 for Virginia). The larger of the two populations occurs inside National Guard Training Center-Fort Indiantown Gap (NGTC-FIG), an approximately 6,925-ha military base located in south-central Pennsylvania. Comprehensive descriptions of the old-field successional habitats occupied by *S. idalia* at NGTC-FIG are presented in Barton (1996) and TNC (2001). Morphologic and genetic evidence indicates that eastern populations may deserve specific or subspecific status and designation as an evolutionary significant unit (Williams 2001a, 2001b, 2002). In light of the conservation status of *S. idalia*, research is warranted on its life history.

Nocturnal foraging on *Viola* species has been reported or referenced for *S. idalia* larvae by Holland (1898), Ferris & Brown (1981), Opler & Krizek (1984), Schull (1987), Royer (1988), Iftner *et al.* (1992), Royer & Marrone (1992), and West (1998). However, Kopper *et al.* (2001) documented diurnal feeding on *V. pedatifida* G. Don (Violaceae) in three out of 12 *S. idalia* larvae observed in Kansas. At NGTC-FIG, Barton (1995) reported diurnal movements of *S. idalia* larvae and noted the predominance of *V. sagittata* Aiton relative to the presence of other *Viola* species but did not describe larval foraging behavior.

Because *S. idalia* larvae have been challenging to locate in the field across the species' range (Scudder 1889 for New England, TNC 2001 for Pennsylvania, Kopper *et al.* 2001 for Kansas, Debinski pers. com. for Iowa), behavioral observations of larvae have been difficult to obtain (Kopper *et al.* 2001). A combination of factors such as low population density (Barton 1995), small body size, solitary distribution, cryptic coloration and behavior (Stamp & Wilkens 1993), high mortality rates (Mattoon *et al.* 1971, Wagner *et al.* 1997), and concealing vegetation may partially explain the modest numbers of field-documented larvae. Previous surveys conducted at NGTC-FIG to detect larvae have resulted in very small sample sizes (n = 9; Barton 1995) or failure (n = 0; TNC 2000, 2001).

On May 14, 2001, one *S. idalia* larva was unintentionally discovered at the Pennsylvania site during a vegetation study. Shortly thereafter, a qualitative survey of selected grasslands, known to be inhabited by *S. idalia* adults during previous years, was performed in an attempt to detect more larvae. Typically conducted between 0900 and 1600 hrs, the survey followed a generalized protocol: searching for individuals and groups of *V. sagittata* (including arrow- and ovate-leaved varieties), inspecting violets for evidence of strip-feeding herbivory (typical of *S. idalia*), and visually scanning violets and the surrounding area for larvae. Images of *S. idalia* larvae in Allen (1997) and Richard & Heitzman (1987) assisted with positive species identification.